

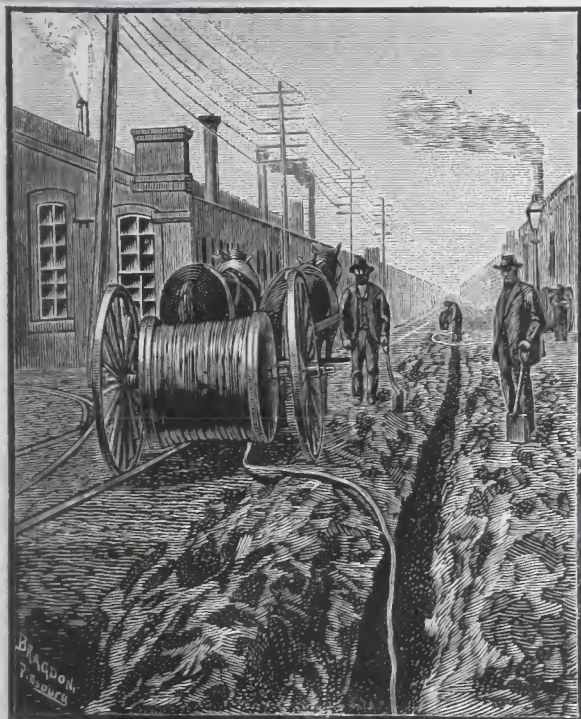
401-8

THE STANDARD

UNDERGROUND CABLE CO.

underground electric cables

Office, No. 88 Fourth Avenue,



Works, 16th & Pike Sts., Pittsburgh, Pa.

Manufacturers of

Telegraph, Telephone and Electric Light Cables,

LEAD COVERED WIRE,

for

Electric Bells, Burglar & Fire Alarms, &c.



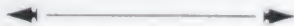
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OFFICE,
No. 88 FOURTH AVENUE.
PITTSBURGH, PA.



WORKS,
16th AND PIKE STREETS.
PITTSBURGH, PA.

1884.

RECEIVED
JUN 11 1881
PITTSBURGH

PRESS OF
PERCY F. SMITH,
PITTSBURGH.



JNO. H. DALZELL, President.

R. S. WARING, Vice President.

M. W. HAYWARD, Secretary.

— DIRECTORS: —

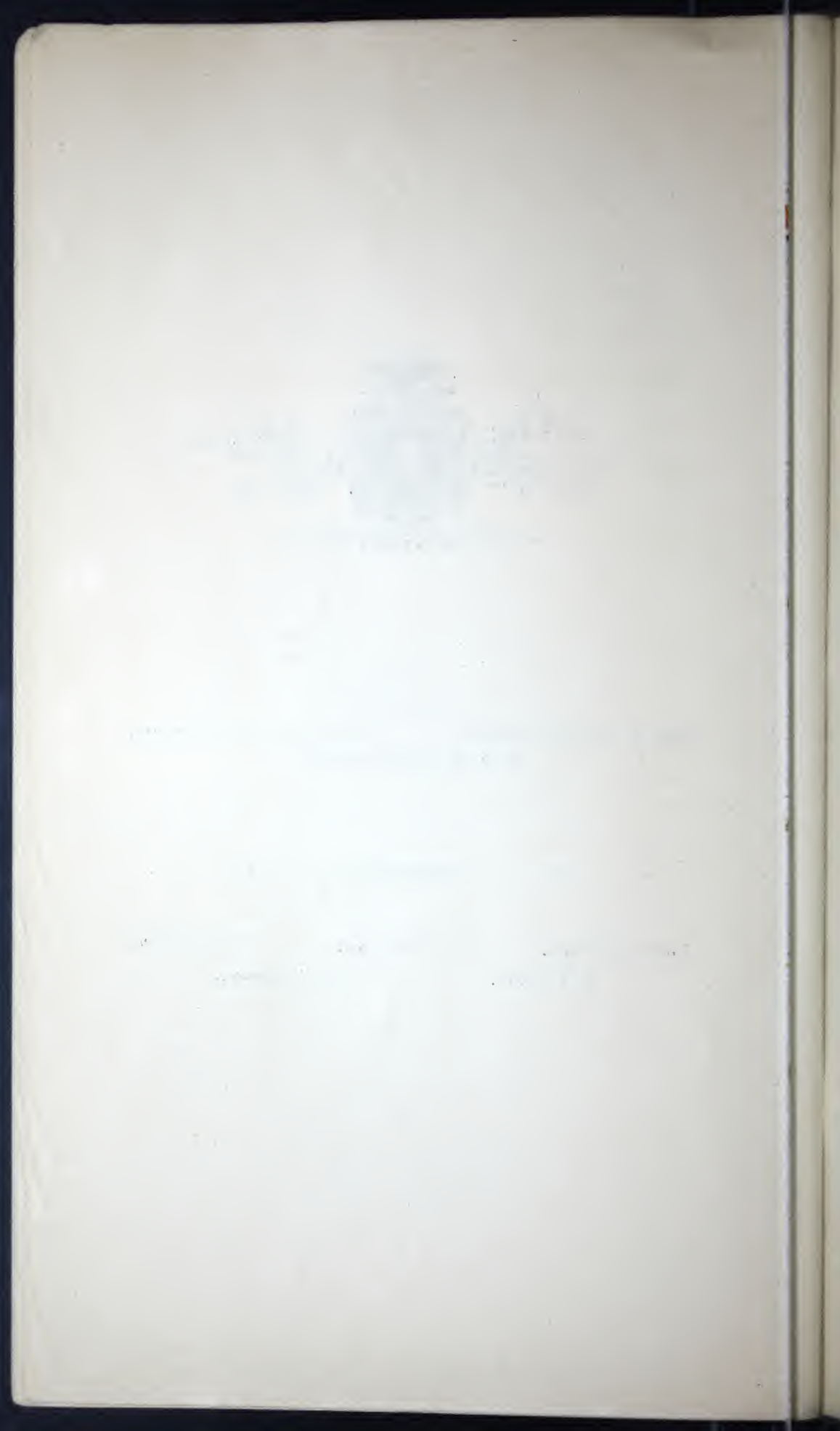
JNO. H. DALZELL.

M. W. WATSON.

R. S. WARING.

B. F. JONES.

O. T. WARING.



Standard Underground Electric Cable.

THE strong public feeling against telegraph and telephone poles and wires, and the manifest advantages of placing all electric conductors under ground, but more especially in cities, have directed public attention in this country to this method of operating such conductors.

Within the past few years many systems of underground wires have been suggested and tried with varying degrees of success. From the earliest days of telegraphy, electricians and skilled mechanics have attempted to devise means for accomplishing this desired result. The advantages of such construction were so obvious that large amounts of money were expended by Prof. Morse and others in this direction; but their efforts were unsuccessful. They were compelled, after many failures, to fall back upon the make-shift of poles and other overhead supports for the wires. These crude and temporary devices still cumber the streets, vex the eye and endanger the lives and property of the community.

The history of invention is full of a long line of unfortunate projectors who have grappled with this question in vain. Many of their devices were so entirely impracticable upon their face that they would not be considered for a moment by any one having a practical knowledge of the subject; but others of more skillful design have partially succeeded, and enough was done, especially in foreign countries, to show that there was good reason to hope for a complete solution of the problem. The many arguments in favor of this change are too well known to require more than the briefest mention. The strongest of these, perhaps, from the standpoint of the electrical companies, is the great unreliability of overhead conductors, subject, as they are, to all the changes of weather, and at times entirely disabled by wind and rain storms; causing an entire suspension of business for many hours at a time, and costing hundreds of thousands of dollars annually for repairs.

Viewed from a public point these pole lines are also objectionable ; disfiguring the public streets, obstructing firemen in their duties, and in numerous instances causing, in one way or another, direct loss of life.

In Europe, many lines of telegraph and telephone are worked under ground, especially in France, Germany and Great Britain ; and judging from surface indications, it would appear that the time has come when American companies also must rid the streets and public highways of these obstructions, and the question of how to do this economically and successfully is receiving general attention at the present moment.

Many of the so-called underground schemes are practically worthless, conceived, as they have been, by men outside of the business, lacking knowledge of the difficulties to be encountered, and of the results necessary to attain, and after one or two trials and large expenditures of money they are abandoned.

THE WARING SYSTEM.

It has remained for Mr. R. S. Waring, of Pittsburgh, to accomplish this long sought result. His inventions possess many important and original elements, which are unknown to any of the other systems. Among these new and distinct features are the ingenious and efficient methods of avoiding the interfering effects of induction, by which it is possible to work long lines of telephonic and telegraphic communication with entire success. We can assert with confidence, that there is no system yet known, outside of the Standard Cables, which solves the difficult problems involved ; and the attention of telegraph, telephone and electric light companies is invited to the manufactures of the Standard Underground Cable Company operating the numerous patents of R. S. Waring, and others, and to the undeniable success of their cables already in operation.

The underground cables made by the Standard Company are well adapted for all uses of the present overhead wires, and where substituted for such wires, have been a great improvement and have given universal satisfaction. The cable, consisting of a heavy lead body is made in different sizes and with a different number of conductors, according to the service for which it is intended, and with any desired gauge of conductor from No. 4 to No. 26.

For street service, fifteen hundred cable wires may be laid in a box, not larger than a foot square ; the cables being very flexible, are easily and quickly handled, and will pack in small compass. The

great flexibility of the Standard Cable prevents damage thereto by settling of the ground from frost, or other causes, and allows the cable to be used inside of buildings, where a more rigid structure would be a serious drawback.

TELEPHONE WIRES UNDERGROUND.

Made in suitable lengths for handling, it is coiled on reels and securely boxed ready for shipment; and when properly laid, will last for an indefinite period. Lead, one of the most durable of metals when buried, has been taken from the ruins of Herculaneum and found in perfect condition, nearly two thousand years after it was made; and, aside from mechanical injury, the length of time which the lead will last may be fairly taken as the lifetime of the cable.

This cable is without doubt the best telephone cable that has ever been devised and perfected, because of its entire freedom from all effects of induction; the metallic sheath of each individual conductor serving to screen it from the induced currents from other wires and insuring perfect silence in the telephones. Where air lines are connected to a short length of cable, the latter has been found to act as an induction killer. In the spring of 1882 a line of this cable containing five wires was laid from the Vesta Oil works on the Allegheny River to the Chamber of Commerce building in Pittsburgh, the total length being within a fraction of nine miles. Over the wires of this cable telephone communication is entirely successful; the conversation from one end to the other being easier and more distinct than would be the case on an air line five hundred feet long. A telegraph or Morse line working in the same cable fails to produce any disturbance whatever in the telephones. This cable was laid in the earth without box or protection of any kind.

THE SYSTEM IN WASHINGTON.

A large amount of cable has also been laid in Washington City by the Standard Cable Company, for the use of the United States government, by which the Capitol, Executive Mansion, State, War and Navy Departments have been connected together for both telegraph and telephone purposes. During the past winter these wires have frequently formed the only lines of communication open; all the air lines having been interrupted by stormy weather.

A line of cables was also laid in Washington for the use of the District government, taking the place of one of their trunk lines of fire alarm and police telephone wires; and the system has received the

hearty endorsement of all of the public officials of both District and National governments. Eight months uninterrupted experience, of the line laid for the city, shows that the system is well adapted for and fullfils all the requirements of a complete and first-class municipal system; the wires used for signal and alarm circuits working in the same cable with the telephone wires. The report to Congress of the Secretary



FIG. 1.

of War as to the working of the Waring system will be found in the appendix. The cables laid in Washington were nearly similar to that laid in Pittsburgh, the only difference being in the addition of a sixth conductor. Figure 1 shows a sectional view of the Washington cables. It will be observed that one of the ridges of this cable is slightly different from the others; the sharp edge or corner serving to designate the number of that particular conductor, from which any of the others can be readily found. One of the great advantages of the Waring Cable is the ease with which any particular wire can be looped out from the main cable, without cutting the cable or disturbing the other conductors; and the utility of the marked ridge of the cable by which this is made possible, will be readily understood. Figure 2 shows a short

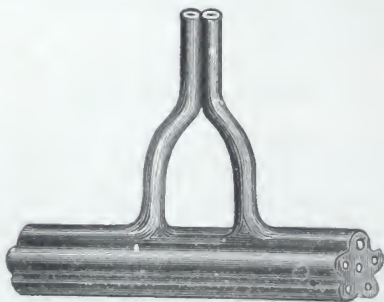


FIG. 2.

length of the cable from which one wire is looped out to a way office. Connections of this kind are made with a two-wire cable which is shown in section, Fig. 3.

TELEGRAPH AND RAILROAD SERVICE.

For the telegraph service also the cable has been thoroughly tested and is a pronounced success. The insulation is upwards of two hundred megohms per mile; and in those portions of the cable first made has not deteriorated any, thus insuring the permanency of this high



FIG. 3.

figure. In specific inductive capacity, this insulation ranks among the lowest of all insulating materials known; hence the static effect is not nearly so great as in gutta percha or kerite cable. All of the many experiments made on this cable with the different systems of printing telegraph, and with the quadruplex, have been entirely satisfactory.

Of all of the great industries of the country which suffer from an interruption of telegraphic facilities, none, probably, are so dependent on such means of communication as the railroads. With every storm of any degree of severity, or extent of area, the lines are interrupted, block signal systems disabled, and travel obstructed. The immense importance of uninterrupted communication between the train-master's office and various telegraph stations along the road cannot be overestimated. Nevertheless it is frequently the case, that in heavy storms, when landslides and washouts occur, trains, losing their schedule rights, are laid out because of the destruction of the air lines and the inability of train dispatchers to communicate with the conductors by telegraph. The attention of railroad managers is particularly asked to the Standard Cable in this connection; and to the ease and certainty with which their wires may be placed beyond the reach of such dangers.

For submarine work the Standard Underground Cable Company are prepared to furnish a first-class cable, complete in all the requirements for such use, heavily armored, and of sufficient tensile strength to guarantee successful wear and long service.

Lightning, the great enemy of underground cables, has never caused any trouble with this cable; although a section of it connected with overhead wires has been worked during the present summer, without any lightning arrester or other protection.

The insulating material, which will not carbonize at less than 1800

degrees of heat, may be melted by a heavy charge of lightning; but resumes its former condition without injury.

ELECTRIC LIGHT WIRES.

The high insulation qualities of the Standard Cable and the exemption from danger to the insulation, from heat or heavy electric currents, make it the best cable in the market for Electric Light wires.

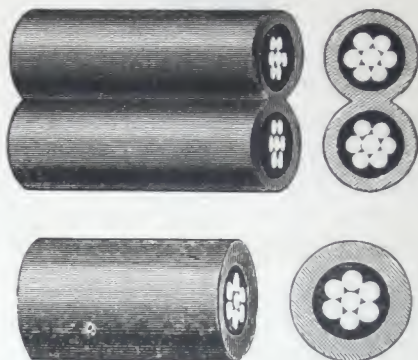


FIG. 4.

Cables for this purpose of Nos. 4 and 6 gauge stranded conductors are shown in Fig. 4. Cable of this style for arc lightning is made in large quantities by the Standard Company and smaller cables for incandescence lights are also made.

ELECTRIC LIGHTS IN MINES, STEAMERS, &C.

The use of incandescence lamps on ocean steamers has become very general within the last few years; and there can be no question as to the great advantage which such lights possess over the oil lamps of former days. But on all such vessels, and especially those constructed of iron, the protection of the insulation has been a serious question; and for this purpose the cables manufactured by the Standard Company are unequalled. In other localities, where the use of Electric Lights has been impossible, because of the difficulty in preserving the insulation, the Standard Cable will be found to have opened a new field for electric illumination. Notably is this the case in coal mines, where the ordinary safety lamps give very little light, and have been known in certain cases to have caused explosions. The incandescent light, enclosed in an air-tight globe, and surrounded by a strong glass case would give an abundance of light without any danger whatever. But such use of the

Electric Light has heretofore been out of the question, because of the impossibility of protecting the leading wires from the prolonged action of dampness. With the introduction of the Standard Cable this difficulty is entirely removed, and the extended use of incandescence lamps in the mining industry, is probably a question of but a few months.

LAYING AND SPLICING.

In the process of manufacture the cable is made in continuous length, and is only cut into such lengths as can be properly handled in the laying. The six-wire cable made for Washington City was shipped in half-mile lengths. The joint or splice made on this cable is shown in Figure 5. The cable ends are first stripped of the lead for a distance of an inch and a half; the wires bared of the insulation are

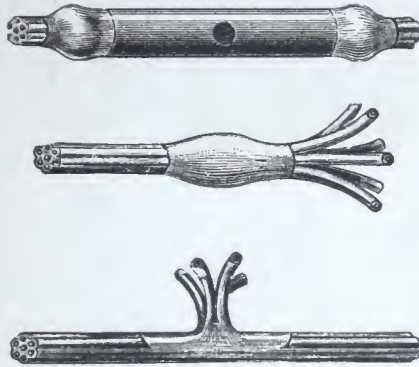


FIG. 5.

then united in a double twist and soldered. The wire joint is then covered with the insulation and wrapped with silk, and afterwards served with strips of sheet lead to preserve the metallic continuity of the division between the wires. A sleeve of lead pipe, previously slipped on one of the ends, is then brought up over the joint and dressed in close to the cable at both ends, and a solder joint wiped at each end of the sleeve. This sleeve is then tapped and the melted insulation run into the pipe so as to fill it up and drive out all air and moisture. The tap is then closed and the joint laid down. No trouble has ever been found in any of the joints, the making of which occupies about one hour each.

The practice in laying the cable has been to dig the trench about two feet deep—a foot or two outside the curb—and drive the reel

mounted like a hose carriage along, paying off the cable as it moves, and filling the ditch in as quickly as the cable is laid in. In

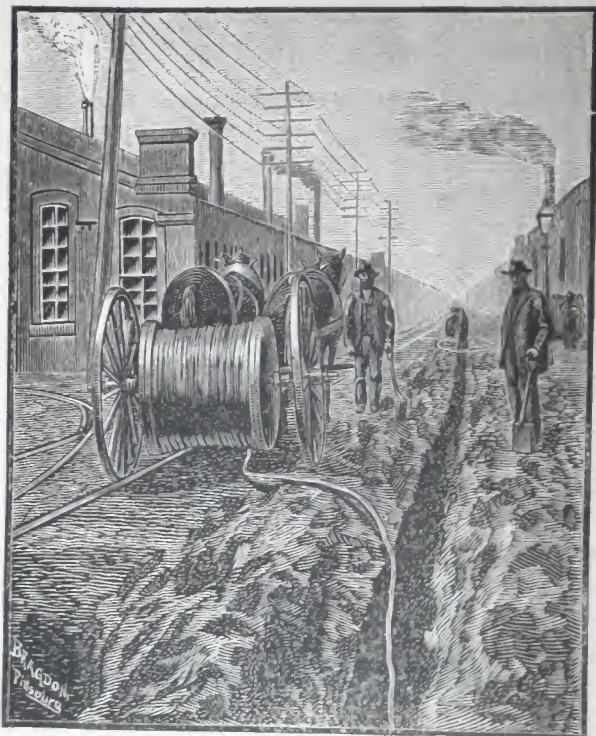


FIG. 6.

this way over a thousand feet per day have been laid; and this figure can be largely increased where the necessities of the occasion require it.

USE OF LEAD COVERED WIRE IN BUILDINGS.

Among the many forms of lead covered wire made by the Standard Company, none probably is capable of such a variety of uses as the single lead covered wire shown in Fig. 7. For burglar alarms, hotel annunciators, electric bells, clock wires, etc., this wire is admirably adapted. It can be laid in the walls of a building while the latter is being erected, and can be plastered entirely out of sight; and being impervious to moisture, is not damaged by the wet plaster. Each wire also carries the ground with it in the lead cov-

ering, thus saving, in many instances, the stringing of a second wire. Every large building in course of construction should be provided with a number of such wires in each room, leading to some convenient point where connection can afterwards be made as the wires are wanted,



FIG. 7

and thus save the vexatious work of stringing these wires after the building is finished—frequently a matter of great difficulty, and only accomplished with considerable damage to the building.

In the case of buildings already finished, the flat or ribbon cables, made by the Standard Company, can be laid on the wood work as an additional moulding; and when stained and varnished to correspond with the interior decoration, will give a handsome finish, avert the necessity for loose wires, and avoid the mutilation of plastered and painted walls.

Especially is such wire equipment desirable in all buildings of offices or separate tenement or apartment houses; and anticipating the requirements of the trade in this direction, the Standard Cable Company are prepared to manufacture this wire in large quantities. The best machinery, built specially for the manufacture of the different styles of cable, has been erected in the extensive factory on Sixteenth street; and the management of the works entrusted to the ablest and most experienced men procurable in the country. The corps of electricians, lead makers and machinists, in charge of this department, is a sufficient guarantee of the high efficiency of the work. Other styles of cable made by the company are shown in Fig. 8, any and all of which the company are prepared to furnish at short

notice, and to lay and turn over in perfect working condition under guaranty.

In all of the different styles of cable shown, and in other forms and sizes, which the Standard Company are prepared to manufacture to special order, the same high degree of excellence in workmanship

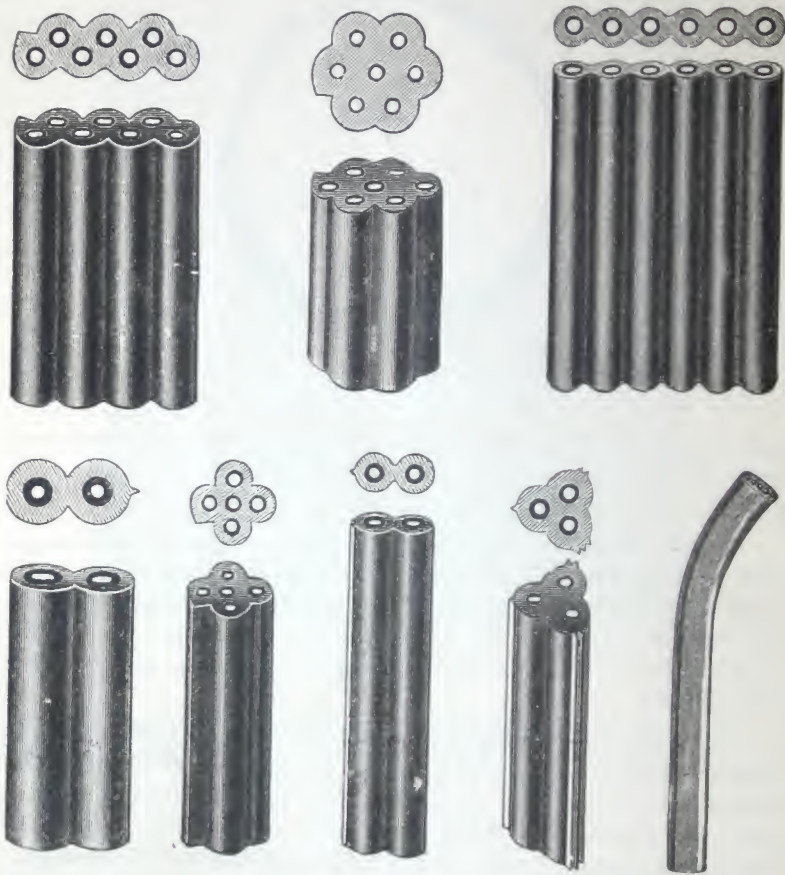


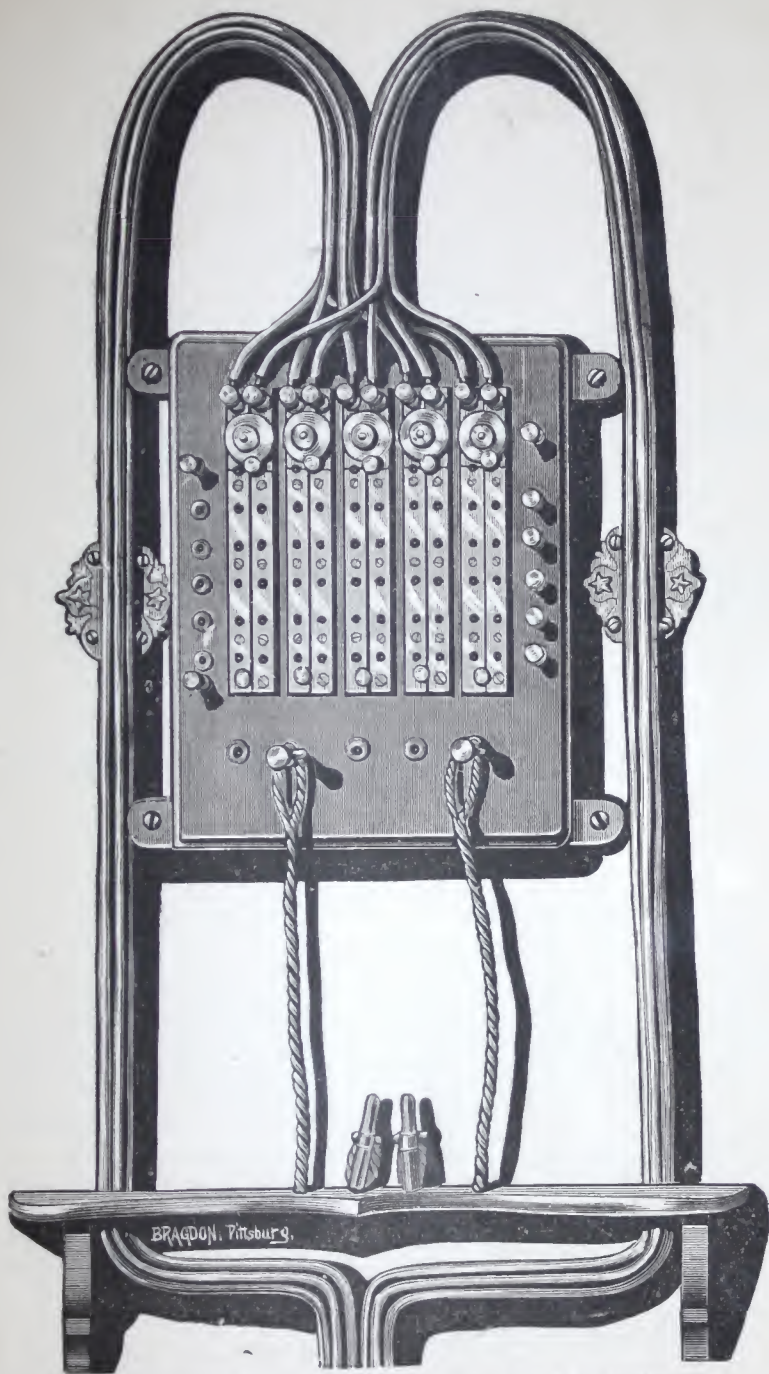
FIG. 8.

and durability are guaranteed; no piece of cable being allowed to leave the factory until inspected, tested, and passed by the electrical engineers in charge. For any and all of the purposes for which overhead wires are used in telegraph, telephone or electric light plants, railroad ser-

vice or domestic use, this cable may be rapidly and economically substituted; and whether run in sewers, or other subterranean conduits, buried in the earth, or laid under water, will always insure the same essential features of perfect insulation, great durability, and total absence of the annoyances and dangers due to induction.







Cable connections in the 11th Street office of the A. V. R. R., Pittsburgh.



LETTER

—FROM—

THE SECRETARY OF WAR

TRANSMITTING,

In response to Senate resolution of June 23, 1884, reports respecting the workings of the underground telegraphic cables laid between the Capitol and Executive Departments.

JUNE 25, 1884.—Referred to the Committee on Public Buildings and Grounds and ordered to be printed.

WAR DEPARTMENT,
Washington City, June 25, 1884.

The Secretary of War has the honor to transmit to the United States Senate copies of various reports, correspondence, &c., respecting the workings of the underground cables, laid by the Standard Underground Cable Company of Pittsburgh, between the Capitol, Executive Mansion, and State, War, and Navy Departments, in response to Senate resolution of June 23, 1884, as follows:

Resolved, That the Secretary of War be directed to communicate to the Senate all information in his possession relating to the underground system, known as the Waring system, of telegraph and telephone conductors, connecting the Capitol and the several Executive Departments.

ROBERT T. LINCOLN,
Secretary of War.

THE PRESIDENT PRO TEMPORE OF THE UNITED STATES SENATE.

REPORT OF Col. A. F. ROCKWELL, U. S. A.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS,

Washington, D. C., May 6, 1884.

Brig. Gen. JOHN NEWTON,

Chief of Engineers, U. S. A., Washington, D. C.:

GENERAL: In submitting the following report upon the working of the underground cable, recently laid for experimental purposes between the Capitol, the Executive Mansion, the State War and Navy Departments, and this office, by the Standard Underground Cable Company, of Pittsburgh, I have deemed it advisable to preface the same with a *resume* of the action taken by this office prior to granting the permit for the laying of the cable in question.

On the 14th of September, 1883, a letter was received by this office from Mr. Dan. S. Robeson, general manager of the Standard Underground Cable Company, offering, on behalf of that company, to lay, absolutely free of cost to the United States, an experimental line of its cable between the Capitol, the Executive Mansion, and the War Department. This proposition was submitted to the Chief of Engineers on September 20, with a favorable recommendation, and of the approval of the same by the Secretary of War I was advised on September 26.

Under the terms and conditions mutually agreed upon October 3, and approved by the Chief of Engineers October 9, the permit was issued, and in accordance therewith the Standard Company has laid cables as follows, all without cost to the United States.

From the cable-box in the vaults under the Senate wing of the Capitol start two cables of six wires each, which, passing out through an old brick conduit under the Capitol grounds to B street north, run under said street to First street west, to Pennsylvania avenue, to Third street west, to Missouri avenue, to Sixth street west, to B street north, to Fifteenth street west, along east side of grounds south of Executive Mansion to and through the Executive Mansion grounds to Seventeenth street west, to Pennsylvania avenue, one cable entering the office of Public Buildings and Grounds, the other running to cable-box in sub-basement of War Department building. In addition to these two cables, a third is laid on part of same route, commencing at the corner of Sixth and B streets northwest, and ending at the corner of New York avenue and Seventeenth street northwest, with which third cable no connections have as yet been made.

In the Capitol building, one cable has been run from the cable-box in the vaults to the office of the Secretary of the Senate, and another from same cable-box to the corridor at the western end of the House lobby. There is also a cable running from the office of the Secretary of the Senate to the telegraph office on the House side.

In the State, War, and Navy Departments building there is one six-wire cable running from cable-box in sub-basement of north wing

to each of the telegraph offices in the three Departments. There is also one six-conductor cable running from the office of Public Buildings and Grounds into the cable box in sub-basement of War Department building, two cables connecting with main line and running into the Executive Mansion, and one cable connecting with main line and running into the National Museum building in the Smithsonian grounds.

The present line of wires used for telegraphic purposes through these cables starts from office of Public Buildings and Grounds, thence through State, War, and Navy Departments and Executive Mansion to Senate and House of Representatives, where it ends.

The wires of the cable system now in service are as follows: One telephone wire (part aerial line) from this office to greenhouses on the Monument grounds; one telephone wire (part aerial line) from National Museum building to the carp ponds on Monument grounds; one wire from National Museum to headquarters fire alarm service, District of Columbia; for fire-alarm service (not yet connected); one wire from the War Department through Executive Mansion and Smithsonian Institution to United States Senate, used for time signals from the National Observatory; one telephone wire from this office to room of House Committee on Public Buildings and Grounds in Capitol; one telephone wire (part aerial line) from Pension Office to room of Senate Committee on Pensions, and one telegraph (or Morse) wire connecting this office, the State, War, and Navy Departments and Executive Mansion with the Capitol.

The original object of the tests was to determine the practicability of removing the present unsightly wires and poles of the departmental telegraph, which at present not only disfigures the public buildings and grounds, but are a perpetual source of danger, annoyance, and expense; and the substitution therefor of an underground line, which should perform the service required, at least as well, if not better.

These tests and experiments have been numerous and thorough. They were conducted during a considerable period of time and by a large number of persons. The detailed results, interesting and important, are embodied in the various letters which accompany this report, and to which special attention is invited. (See inclosures A to Q, inclusive.) Their weight and value will be duly estimated, not only by the scientific attainments, but the practical experience of some of the writers. From their consideration, and from my own observations, and frequent participation in the tests and practical working for both telegraphic and telephonic purposes, I express the opinion that the experimental cable laid by the Standard Underground Cable Company, fulfills all the requirements of the service as an efficient and practical substitute for the present overhead system.

I have the honor, therefore, to respectfully recommend the adoption of the cable system for the departmental telegraph line, and its extension to include all the Departments of the Government in this city so soon as practicable, and thereafter, the removal of all aerial wires and poles from the public buildings and grounds.

It will be observed that in the conduct of the various tests and experiments, not only the telegraph, but the telephone has been used. The manifest advantages of the underground system for telephonic uses are fully set forth in the accompanying letters, and I venture to suggest the expediency of the introduction of a departmental telephonic service in connection therewith.

In conclusion, I have to record an acknowledgment of the hearty co-operation and assistance of the Commissioners of the District of Columbia

Very respectfully, your obedient servant,

A. F. ROCKWELL,
Colonel United States Army, in Charge.

[Inclosure A.]

PROFESSOR BAIRD TO COLONEL ROCKWELL.

SMITHSONIAN INSTITUTION,
Washington, D. C., April 26, 1884.

SIR: I am in receipt of your letter of April 21, asking for my opinion as to the merits of the system of transmission of telephonic signals for the underground cable.

In reply, I beg to say, that I embraced the opportunity offered by the recent meeting, in Washington, in the National Museum building, of the National Academy of Science, to refer the subject to experts, conspicuous among whom was Professor Barker, well known in connection with electrical science.

Several different telephonic instruments were arranged, so that the messages could be sent either by the underground cable or by the air wires, by simply changing a switch.

The apparatus were subjected to careful tests, and I was informed by the experts that, in their opinion, the underground system was very decidedly the better one, being free from *many* if not *all* the disadvantages of the old system

Very respectfully, yours,

SPENCER F. BAIRD,
Secretary Smithsonian Institution

COL. A. F. ROCKWELL,

In charge of Public Buildings and Grounds, Washington.

[Inclosure B.]

PROF. G. F. BARKER TO COLONEL ROCKWELL.

UNIVERSITY OF PENNSYLVANIA,

Philadelphia, April 21, 1884.

SIR: While in Washington last week I examined somewhat carefully the underground cable now working in the streets of that city, made, as I understand, under patents held by R. S. Waring, of Pittsburgh. In my judgment, the theory of this cable is scientifically sound. Its anti-induction feature consists in the use of metallic screens between the wires—a device the effectiveness of which was first pointed out by Professor Henry. Protection from leak is secured by excellent insulation. In practice the cable seems to answer all requirements. Conversation was readily carried on over circuits 2.6 and 4 miles respectively, and this with various forms of telephone. A remarkable freedom from extraneous noises was observed, the articulation, in consequence, being sharp and clear. I made a test of the insulation-resistance of this cable, using for this purpose the section which extends from Seventeenth street and Pennsylvania avenue to the Capitol, a length, as I was informed, of 2.6 miles by the route taken. The instruments employed in the measurement were those in use in the office, and the results, therefore, can be considered only approximate. It appears from this test that the cable-insulation had a resistance of between two and three hundred megohms per mile.

Abundant evidence is at hand that the working of the telegraph lines through the cable is in every way satisfactory. Tapping of wires being impossible, secrecy is assured. The retardation predicted of underground cables has not in any case been noticed.

The Waring cables therefore, both by its excellent insulation, its protection from induction, and the facility with which it may be manufactured and laid, admirably fulfills the requirements of a first-class underground conductor.

Respectfully, yours,

GEORGE F. BARKER.

COL. A. F. ROCKWELL,

Superintendent of Public Buildings and Grounds, Washington.

[Inclosure C.]

S. P. LANGLEY TO COLONEL ROCKWELL.

Allegheny, Pa., April 30, 1884.

SIR: Learning that you desire an expression of my opinion on the Waring underground cable, I write to you to say that in December, 1881, Mr. R. S. Waring left with me a sample of his lead-covered

underground cable, for examination, in respect to its quality as a working cable, and especially in reference to its elimination of induction noises. The insulation, as far as could be judged from the sample at command, was practically perfect, and the character of the copper as to conductivity excellent.

The special experiments indicated that when the leaden covering of the cable was grounded, the induction sounds were decreased in volume by about 98 per cent., or in other words, were reduced to about one-fiftieth of their original intensity. This has reference to the sample originally submitted, in which the copper wires were separated by a winding of dry cotton from the lead. In the cable as now in use, and which I have not tested, I learn that this has been replaced by a specially insulated copper wire, with which it is claimed that even the small residual induction effect above mentioned has been eliminated.

I can only speak from personal knowledge of the cable submitted in 1881, of which my opinion was favorable.

Your obedient servant,

S. P. LANGLEY.

COL. A. F. ROCKWELL,

Sup't of Public Buildings and Grounds, Washington, D. C.

[Inclosure D.]

A. J. KENNEDY TO COLONEL ROCKWELL.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS,

NO. 1700 PENNSYLVANIA AVENUE,

Washington, D. C., April 15, 1884.

COLONEL: I have the honor to submit herewith a report upon the result of experiments made with the underground cable recently laid between this office and the Capitol, by the Standard Underground Cable Company of Pittsburgh.

Under your permit, dated October 3, 1883, that company began the work of laying the cable on November 1, and on November 23 had completed the laying of two six-conductor cables, between the points specified, and informal tests with both Morse instruments and the telephone gave most satisfactory results.

On December 4, 1883, the first public tests were made, in the presence of representatives of the local telegraph and telephone companies, the local and out-of-town press, the city government, the Signal Service United States Army, and others, and these tests, with both Morse and telephone instruments, were generally satisfactory.

The second public test was made on Friday, December 7, 1883, between Great Falls and the Capitol, on wires running through the cable from the Capitol to this office, and thence via air line to Great

Falls, being a distance of about 18 miles over air line. This test was perfectly satisfactory to all parties present. I was stationed at Great Falls and talked through the telephone with Colonel Rockwell, Lieutenant Allen, officer in charge of telegraph United States Signal Service; Captain Green, of engineer department, District of Columbia; Mr. Miles, superintendent of fire alarm service, District of Columbia; Mr. Conklin, chief clerk Public Buildings and Grounds, and many others. Every word spoken was plainly distinct, though many were in a very low tone of voice. In fact, I never, in all my experience, have used a telephone with more satisfaction.

The third public tests were made on December 15, as follows:

Test No. 1.—Circuit No. 1, from District Columbia fire-alarm office to office Public Buildings and Grounds; thence to Capitol and back through cable; thence to Georgetown. Circuit No. 2, from the Capitol to office Public Buildings and Grounds, and listen for cross talk.

Test No. 2.—Same as above; only return by loop through second cable.

Test No. 3.—Same as No. 1, only substitute Morse for second telephone circuit.

Test No. 4.—Same as No. 2, with Morse circuit.

Test No. 5.—Talk from District of Columbia fire-alarm office to office Public Buildings and Grounds by air-line; then same with one loop of cable in circuit; then same with two loops in circuit; all of which results were perfectly satisfactory.

On December 12, 1883, a test was made by Mr. M. Marean, manager Western Union Telegraph Company, with the Thompson reflecting galvanometer for insulation, which was found to be excellent.

On February 14, 1884, Mr. Marean made a test between New York and Washington with 15 miles of cable, and remainder of air-line. The Western Union quad and printing instruments were worked over it with perfect satisfaction.

February 16, 1884, the greenhouse telephone wire was connected with the underground cable from this office to Fourteenth and B streets northwest, and thence by air-line to greenhouse. This combination has been in daily use since, and is found to give perfect satisfaction.

February 19, 1884, the Senate, House of Representatives, and Executive Mansion were connected by Morse instruments, which work very nicely, and had it not been for the underground Morse wire between this office and the Capitol, the Executive Department would have been unable to get Capitol over air-lines during the wind storms of March 7 and 8. By connecting part air-line and part underground cable the Capitol and the Departments were able to get off all business very satisfactorily.

The connection of Morse instruments with the cable into the State, War, and Navy Departments has been completed, and the Capitol, Executive Mansion, State, War, and Navy Departments, and this office are now in perfect connection through the underground cable for telegraphic and telephonic business.

In conclusion, I beg to state that, so far as my experience goes, the Standard Underground Cable system is the best, and for city use will answer all telegraphic and telephonic purposes.

Very respectfully, your obedient servant,

A. J. KENNEDY,

Electrician Departmental Telegraph Line.

COL. A. F. ROCKWELL,

In charge of Public Buildings and Grounds, Washington, D. C.

[Inclosure E.]

O. L. JUDD TO COLONEL ROCKWELL.

EXECUTIVE MANSION,

Washington, D. C., April 22, 1884.

MY DEAR SIR: In reply to yours of the 21st, I have to say that the Morse wire in the underground cable connecting the State, War, and Navy Departments and the Executive Mansion with the Capitol has been used by this office for about two months; during that time the circuit has been invariably strong and reliable, not having, to my knowledge, failed for an instant.

I have, as yet, had no telephonic experience with the cable, but, for the purposes of the Department telegraph its conductivity is all that could be desired, and its insulation against both direct and induced currents is practically perfect.

As to the insulation for very long currents, or its durability, I am not competent to give more than my opinion, which is favorable.

Were the cable system extended to all the Departments, the efficiency of the service would be greatly increased.

Very truly, yours,

O. L. JUDD.

COL. A. F. ROCKWELL,

Superintendent Public Buildings and Grounds.

[Inclosure F.]

HON. G. B. LORING TO COLONEL ROCKWELL.

DEPARTMENT OF AGRICULTURE, UNITED STATES OF AMERICA,

Washington, D. C., April 22, 1884.

DEAR SIR: I understand that it is proposed to establish a system of telegraphic and telephonic communication between the several Executive Departments of the Government and the Capitol and Printing Office.

If this be contemplated I trust that this Department will be included in the system; and having been informed by my electrician of the result of tests, &c., made with the Standard underground wires, I shall be particularly pleased if that method of connection be used, at least so far as the grounds immediately surrounding this Department building are concerned.

Very respectfully,

GEO. B. LORING,

Commissioner of Agriculture.

COL. A. F. ROCKWELL,

Superintendent Public Buildings and Grounds, City.

[Inclosure G.]

COMMODORE S. R. FRANKLIN TO COLONEL ROCKWELL.

UNITED STATES NAVAL OBSERVATORY,

Washington, April 21, 1884.

SIR: While planning for an underground cable to connect the different Departments of the Government, will you please include the Naval Observatory? Several of the officers on duty here have examined the working of the cable which it is proposed to use, and from considerable experience in such matters they are convinced that such a cable would furnish the best possible means for transmitting the time signals which the Observatory sends each day to the Departments.

Reliability in the circuit is of the first importance for our use, and this will be secured better by an underground cable than by an air line.

Very respectfully,

S. R. FRANKLIN,

Commodore, Superintendent.

COL. A. F. ROCKWELL, U. S. A.,

In Charge of Public Buildings, &c.

[Inclosure H.]

GENERAL W. B. HAZEN TO COLONEL ROCKWELL.

SIGNAL OFFICE, WAR DEPARTMENT,

Washington City, May 5, 1884.

SIR: I have caused the experimental underground cable now connecting some of the Government Departments to be carefully examined by properly qualified persons connected with the telegraphic service of this office, with the following results:

The wires are found to be highly insulated, and the practical tests for telephonic purposes were eminently satisfactory. There was no perceptible retardation or induction. If the cable does not deteriorate too rapidly, which I do not anticipate, it will undoubtedly give satisfaction in connecting the different Departments in this city.

I am, very respectfully, your obedient servant.

W. B. HAZEN,

Brig. and Bvt. Maj. Gen., Chief Signal Officer, U. S. A.

COL. A. F. ROCKWELL,

Washington City.

[Inclosure I.]

G. H. GETZ TO COLONEL ROCKWELL.

UNITED STATES SENATE,

Washington, D. C., April 4, 1884.

SIR: My opinion having been requested as to the advantages of the Waring underground telegraph cable constructed between the Capitol and the several Departments, it gives me pleasure to state that thus far it has worked in an entirely satisfactory manner. An experience of some years as an operator on various lines of wires attached to poles above ground enables me to say that the underground wire is less liable to interruption, and in other respects is far preferable to the old method. Since this line has been in operation I have found no interruption of communication whatever, and believe that it will fully realize all the advantages that have been claimed for it by the Standard Cable Company.

Respectfully, yours,

GEORGE H. GETZ,

Manager Senate Lines of Telegraph.

COL. A. F. ROCKWELL,

Commissioner of Public Buildings.

[Inclosure J.]

C. F. L. BRAULIK TO COLONEL ROCKWELL.

HOUSE OF REPRESENTATIVES,
Washington, D. C., April 4, 1884.

SIR: I beg leave to report on the "Waring" underground cable connecting the House of Representatives with the various Executive Departments of the Government by telegraph and telephone.

This system has been in daily use for several months and has operated to perfection, not having failed in a single instance since its introduction. It is far superior to the old system of air lines. I cannot see how we could do without it; the air lines having frequently ailed us, we are entirely dependent on the underground wires.

The extension of this system to all Departments of the Government in this District would greatly facilitate business.

Respectfully, yours,

CLARENCE F. L. BRAULIK,
 Manager Government Telegraph Line, House of Representatives.
 COL. A. F. ROCKWELL,
 Superintendent Public Buildings and Grounds.

[Inclosure K.]

H. R. MILES TO COLONEL ROCKWELL.

OFFICE TELEGRAPH AND TELEPHONE SERVICE,
Washington, D. C., April 14, 1884.

SIR: I have the honor to transmit for your information concerning the practical workings of the underground "Waring" cable the inclosed correspondence, which fully explains itself.

Mr. Richards, the electrician, who joins in response to my letter of inquiry, is a practical man of large experience, and has been on duty in this department since the summer of 1875. Mr. Noyes has been a practical fire-alarm telegraph operator since the year 1864. Mr. Tompkins is a younger man, but has been a practical telegraph operator for several years.

Last autumn a sufficient length of these cables was put down to enable this department to test quite fully the vexed question as to whether cables may be successfully used for municipal telegraph and telephonic service. It gives me pleasure to state that our experience demonstrates to my satisfaction that the Waring cable meets all the requirements, and I would not hesitate to recommend its adoption for our fire-alarm and telephone service throughout the entire District.

The fact are, we have been using these cables for both fire-alarm telegraph and telephonic service constantly all winter, with the signal and alarm and telephone conductors in the same cable, each and all of which have worked much better than have our air-lines in the same service.

I have been in service constantly since the summer of 1868, and in all this experience have not used an system of wires so thoroughly reliable as I find this cable to be.

Your obedient servant,

HENRY R. MILES,

Gen. Sup't Telegraph and Telephone Service, District of Columbia.

COL. A. F. ROCKWELL,

Commissioner of Public Buildings.

[Sub-inclosure in inclosure K.]

OFFICE TELEGRAPH AND TELEPHONE SERVICE,

Washington, D. C., April 12, 1884.

MESSRS. A. S. RICHARDS, Electrician, and GEORGE H. NOYES and G. R. TOMPKINS, Operators, in charge of Fire-Alarm Telegraph:

For the purpose of obtaining the most reliable information in regard to the practical workings of the "Waring Underground Cable" now in use in our fire-alarm and telephone service in this city, I respectfully request a joint or several opinion from each of you as to whether it has proven successful and satisfactory thus far.

If any defects have developed in the cable, in any way, state them freely and fully.

Yours, very truly,

HENRY R. MILES,

Gen. Sup't Telegraph and Telephone Service, District Columbia.

OFFICE TELEGRAPH AND TELEPHONE SERVICE,

Washington, D. C., April 14, 1884.

SIR: In reply to your letter of inquiry concerning the "Waring, cable, bearing date April 12, 1884, we beg to state jointly that the cable has been working in the most satisfactory manner for both telegraph and telephone service. No defects have been observed, and we are confident none have developed.

So far we are advised, or can ascertain by the most practical tests, the "Waring" underground cable has proven a success.

We have the honor to be, your obedient servants,

A. S. RICHARDS,
Electrician.

GEO. H. NOYES,
G. R. TOMPKINS,

Operators, in Charge Fire-Alarm.

HENRY R. MILES,

Gen. Sup't Telegraph and Telephone Service, District of Columbia.

[Inclosure L.]

T. MORRISON TO COLONEL ROCKWELL.

DEPARTMENT OF STATE,

Washington, April 12, 1884.

DEAR SIR: In accordance with your wish for a report from this office as to the efficiency and merits of the Waring Underground Cable, laid last fall between the Capitol and the State Department, I can cheerfully give the following statement:

The underground Morse system of telegraph connecting the State, War, and Navy Departments, the White House and Capitol and Office of Public Buildings and Grounds, has been in constant operation for some time, and has worked admirably. This line is of course entirely free from all atmospheric disturbances and weather troubles, and is therefore always ready for use. The only drawback in its use is that less than one-half of the offices of the general Government are embraced in the cable system, and when the air lines are down it becomes necessary for some of the offices having the underground wires to repeat business for those points not so provided.

A general extension of the underground wires would certainly prove advantageous, and could not fail to greatly facilitate the Government telegraph service.

Yours, respectfully,

THOMAS MORRISON,
Manager State Department Telegraph Office.

COL. A. F. ROCKWELL,
Superintendent Public Buildings and Grounds.

[Inclosure M.]

C. O. PIERSON TO COLONEL ROCKWELL.

WAR DEPARTMENT,

Washington City, April 12, 1884.

SIR: I have the honor to state that the Standard Underground Cable system, as worked from this Department, has proved a great success, and has at all times and under all circumstances maintained the highest efficiency known in the history of the construction of electrical circuits.

Our "Morse" system which connects the War Department with the United States Senate, House of Representatives, White House, State and Navy Departments, and Office of Public Buildings and Grounds, has worked to perfection, and cannot be too strongly endorsed. Since its introduction in the Department, some three months since, it has never failed in a single instance, and has on numerous occasions been the only outlet between this point and the Capitol. This office has repeatedly relayed the Capitol business through the underground system to such points as could be reached by the air lines when communication by the latter route has been interrupted to that point. Its extension to and introduction in the other Departments would greatly facilitate the transmission of public business by telegraph. Of the many telephonic tests which we have had through this system it can be said, as to the conductivity of the cable, that they have been absolutely perfect, the cable being entirely free from induction, which is one of the greatest sources of interruption of telephonic communication. The electric clock circuit, as worked through this system, which controls the electric clock in the United States Senate, and which is controlled from this office, also works admirably.

We have also working through the "Waring" cable a loop to the Capitol, connecting at that point with the Baltimore and Ohio telegraph system, through which this Department is placed in direct communication with Chicago, Saint Louis, and other points, which is working in the most satisfactory manner.

Very respectfully,

CHAS. O. PIERSON,

Manager War Department Telegraph Office.

COL. A. F. ROCKWELL,

Superintendent Public Buildings and Grounds.

[Inclosure N.]

MRS. ETTA THOMPSON TO COLONEL ROCKWELL.

NAVY DEPARTMENT,

Washington, April 12, 1884.

DEAR SIR: In compliance with your request, I very respectfully report that the Standard Underground Cable has given great satisfac-

tion in the Navy Department, and, in my humble opinion, is an innovation of vast superiority to the old system of air-line communication. It has been very reliable in its workings, and has on a great many occasions been the only means of communication with the Capitol—the air-lines being down.

I indorse it in the strongest possible terms, and believe that its extension to all the Departments would greatly advance the transmission of public business by telegraph.

Very respectfully,

Mrs. ETTA THOMPSON,
Manager Navy Department Telegraph Office.

COL. A. F. ROCKWELL,
Superintendent Public Buildings and Grounds.

[Inclosure O.]

M. MAREAN TO COLONEL ROCKWELL.

Washington, D. C., April 14, 1884.

DEAR SIR: I have made a number of careful tests of the Waring cable laid between your office, the White House, and the Capitol, and have no hesitation in saying that the results exceeded my expectations, and were uniformly satisfactory. The telegraphic tests over different lengths of wire, up to as much as 41 miles, were entirely successful, the 41 miles' circuit containing all of the wires in the three cables on the B street route. It worked perfectly.

As a medium for telephone communication, the cable is, without doubt, the best in the market. The insulation is very perfect; no appreciable loss of the current could be detected by delicate instruments, and the return charge or discharge from the conductors after ten minutes' insulation amounted to probably 90 per cent. of the initial charge.

The feature peculiar to this cable and of the greatest value, however, in the telephone work is its anti-induction qualities, which are as nearly perfect as possible.

Telegraph circuits working in the same cable with telephone lines produce no disturbance whatever on the latter—a result which, so far as I know, is attained in no other underground cable.

Of the numerous telephone tests made by me and by others when I was present, all were very satisfactory, the perfect silence in the telephone being broken only by the voice from the distant end. On several occasions air-lines of different lengths were connected to the underground wires and used for telephoning, not only without difficulty, but with a marked improvement over the air-line service.

As a means of communication by either telegraph or telephone between the different departments of the Government, this cable will answer every purpose and is found far superior to any other system of wires, aerial or underground, with which I am acquainted.

Very respectfully,

M. MAREAN,
Electrician.

COL. A. F. ROCKWELL,
Superintendent of Public Buildings and Grounds.

[Inclosure P.]

W. H. CLARKE TO COLONEL ROCKWELL.

Washington, D. C., April 15, 1884.

DEAR SIR: I have been requested to write to you an expression of opinion of the Waring Underground Cable; and to give a report of our trial test of the same.

We have been using a loop of the underground wires for several weeks past in connection with our general telegraph system, and are thoroughly well satisfied with the results. The loop mentioned consists of two wires from the Capitol to the War Department, and covers a circuit length of over five miles. Through this loop the Government telegraph office in the War Department has now got direct communication with New York, Baltimore, Cincinnati, Chicago, and Saint Louis, and the new service is reported by Mr. Pierson, operator in the above Department, to be working satisfactory.

The cable loop has been connected with one of our Capitol loops, and has been used on report wires daily, working alternately on New York, Pittsburgh, Chicago, and Cincinnati circuits. It has worked splendidly all the time, and so thorough is the insulation and other electrical qualities of the cable that looping in five miles of underground wire has made no perceptible difference in the handling of the circuits. Every day that we have been testing this loop we have used thereon one hundred and fifty cells of gravity battery.

During the telephone tests made between the Smithsonian Institution, the office of public buildings and grounds, the United States Capitol, and the aqueduct office at Great Falls on different occasions during the past month, all of which were entirely satisfactory, the wires used for telephone work were in the same cable in which our telegraph lines and the Government Morse line were working, and no disturbance of any kind was noticeable on the telephone wires.

I am satisfied that this is the best underground system that I have ever seen or tested, and I believe it is the best cable now offered for any use, meeting, as it does, all requirements of telegraph and telephone service.

Very truly, yours,

W. H. CLARKE,

Manager Baltimore and Ohio Telegraph.

COL. A. F. ROCKWELL,

Superintendent of Public Buildings and Grounds.

[Inclosure Q.]

J. T. McCONNELL TO COLONEL ROCKWELL.

WASHINGTON, D. C., April 7, 1884.

DEAR SIR: During a short stay in this city, I have taken the opportunity to test the efficiency of the underground wires which have been laid here by the Standard Cable Company, of Pittsburgh, Pa., for Government use, and at your request respectfully submit the following:

I occupied, as you are aware, for several years, the position of superintendent of the Telephone Company, in Pittsburgh, and am thoroughly familiar with all of the difficulties of telephone work by air-lines or by cables, aerial or underground.

The greatest difficulty heretofore experienced in telephone communication has been caused by what is technically known as "current induction," and is popularly recognized as the humming and crackling sound in the receiver. This is a trouble which is greatly increased by bringing the wires close together, as is necessarily done in all cable systems, but the peculiar construction of the Waring cable interposes a shield which effectually overcomes this difficulty, and renders such wire entirely independent of the others. My trials of the underground system here have failed to develop any faults of this kind, or in fact faults of any kind.

Some time ago I made a series of tests of the Waring cable in Pittsburgh used during the past two years by the Standard Cable Company, for insulation, induction, and resistance. The result was conclusive in each case, the insulation being so high that it could not be measured with the most delicate instruments. The actual showing was so astonishing to me that I fear to state it, but can, if necessary, be qualified to the figures. Relative to induction, the most severe tests have shown that there is no interference whatever from one wire to another, and in conduction, these wires, like any others, can be made capable of carrying any volume of current that may be required.

I would be pleased to furnish you with the details of my experiments in this direction, but judge that what I have already said will be sufficient.

The tests of the Washington cable have been entirely satisfactory to me, the actual every-day working of the wires being evidence of their value as a substitute for the aerial lines now in use. To condense my ideas and opinions in this matter, I will freely state that there are no obstacles in the way of the adoption in all cities of this system. The lasting properties of the cable are to be determined simply by the durability of the lead casing, which, as is well known, can be depended on for many years when properly laid.

Concluding, I will say that, without fear of question, it is the only underground wire system of all the numerous efforts in that direction which meets all the requirements.

With much respect, I am, yours, truly,

JOSEPH T. McCONNELL,

Sup't McTighe Electric Light and Manufacturing Company,
Pittsburgh, Pa.

COL. A. F. ROCKWELL.



LETTERS

—ON—

TEST OF GOVERNMENT CABLES.

Washington, August 21st, 1884

NO. 44 BROADWAY,
New York, August 22d, 1884.

MR. W. H. CLARKE,
Manager B. & O. Telegraph Company, Washington, D. C.

DEAR SIR:—You have, from time to time, examined the underground system laid by my company for Government use; and have also had in use, from time to time, a number of the conductors working in your own circuits, and have been so kind as to inform me that they have worked satisfactorily under all occasions.

I understand that you participated in the test made yesterday; if so, do me the favor to give me the result of the test.

Yours very respectfully,

RICHARD S. WARING, V. P.,
Standard Underground Cable Company.

Endorsed on the back of the above letter is the following: “Respectfully returned to Mr. R. S. Waring. The statements contained in the first paragraph of your letter are true in every particular.

In reply to the inquiry contained in the last paragraph, I have to say that I was present at all the tests made on August the 21st inst., of your underground cable laid in this city for Government purposes, and that all the tests were perfectly satisfactory in every particular.

Very truly yours,

W. H. CLARKE,
Manager.

OFFICE OF SUPERINTENDENT STATE, WAR AND
NAVY DEPARTMENT BUILDING.

Washington, Aug. 23d, 1884.

MR. RICHARD S. WARING,
Vice-Pres. Standard Underground Cable Company, New York.

MY DEAR SIR:—Having a few moments to spare, I shall employ them in conveying to you information which must be agreeable to you, though perhaps you may say that it is what you naturally had reason to expect.

On Friday, I witnessed a test of your underground cables, laid in this city for the use of the Government. There were a number of experts and scientists present, first in the office of Col. Rockwell and then in this building. They all expressed themselves perfectly satisfied and greatly pleased with the exhibition of comparatively *perfect* insulation of the entire system of underground wires; indeed, nothing more satisfactory could be desired than the results of every test and experiment made, all of which were so carefully done.

With congratulations upon the perfection which you have attained in the practical use of underground wires and the durability which your system assures, I am,

Very respectfully yours,

HENRY L. SNYDER,
Chief Engineer U. S. N.
Superintendent.

U. S. NAVAL OBSERVATORY,
Washington, D. C., Aug. 26th., 1884.

MR. R. S. WARING,
Vice-Pres. Standard Underground Cable Co., No. 44 Broadway, N. Y.

DEAR SIR:—In answer to your letter of the 22d inst., I would state that I had the pleasure of being present and witnessing a test that was made of the Waring Underground Cable, connecting the office of Col. Rockwell and the War Department building with the Executive Mansion, National Museum and Capitol. Quite a heavy battery and a sensitive galvanometer were used for making the test. All the circuits were found to be in good working condition and the insulation perfect. The tests were made about August the 19th,—the exact date I have forgotten.

Yours very respectfully,

E. C. PENDLETON,
Lieutenant U. S. Navy.

WAR DEPARTMENT,
Washington City, Aug. 23, 1884.

MR. R. S. WARING, V. P.,
Standard Underground Cable Co., 44 Broadway, N. Y.

SIR: I have the honor to acknowledge the receipt of your letter of August 22d, asking for the result of the test of the underground

wires laid by your company in this city in December, 1883, which was made in the office of the Superintendent of Public Buildings and Grounds, on the evening of the 21st. inst.

In reply I beg to state, that the above mentioned test was surprisingly satisfactory to all present on that occasion—that for insulation particularly so, the most delicate instruments failing to indicate any leakage whatever.

Very respectfully yours,

CHARLES O. PIERSON,
Manager War Department Telegraph Office.

U. S. NAVAL OBSERVATORY,
Washington, D. C., Aug. 23, 1884.

DEAR SIR: In reply to your letter of the 22d. inst., I would state that in company with Lieut. Pendleton, U. S. N., Engineer Snyder, U. S. N., Col. Clarke, Manager B. & O. Telegraph Co., and Mr. Marean, of the Western Union Telegraph Co., I witnessed the test of the Standard Underground Cable. The test was thorough in every respect and perfectly satisfactory. Up to the present time the cable works perfectly and is used daily over its entire length by the Naval Observatory.

Yours, &c.,

W. F. GARDNER,

To RICHARD S. WARING,

Vice-Pres. Standard Underground Cable Co., 44 Broadway, N. Y.

ROYCE & MAREAN, ELECTRICAL SUPPLIES.

Washington, D. C., Aug. 26, 1884.

COL. R. S. WARING,

Vice-President, &c.

DEAR SIR: I was present at the office of Col. Rockwell, Commissioner of Public Buildings and Grounds, with others, on the 21st inst., and assisted in making careful tests of the Waring cables connecting the above named office with the Executive Mansion, U. S. Capitol and other Government Departments, which were put down in the fall of 1883. Each conductor was tested separately between the two terminals of the cables, and all were found to be in perfect condition as regards both conductivity and insulation; in fact, the results obtained were highly favorable and entirely satisfactory in every respect.

Very truly,

M. MAREAN.

OFFICE TELEGRAPH & TELEPHONE SERVICE.

Washington, D. C., August 30, 1884.

MY DEAR SIR: In compliance with your request for information as to present condition of our underground wires, I am happy to state that the insulation remains perfect on *all* the conductors, and that the entire system works as well as could be desired for both telegraphic and telephonic service.

Recently we enlarged the underground service of the Fire-Alarm Telegraph by using your cable from the National Museum to Central office instead of the old air-line, as the return end of No. 6 Signal circuit (metallic) and in order to do so, we had to cut the conductor in the cable at two different points, and run cable loops to signal boxes along the route, and find that it is both simple and practical to do so.

In fact, I have found your cable better adapted for Municipal Telegraph and Telephone Service than any other form of cable I have yet seen, for the reason that it may be looped to and from any given point as successfully as air-lines.

We have been using these cables of your's—covering eighteen conductors, for eight or nine months with good results and great satisfaction. I can see no reason why your cable may not prove as durable as anything constructed by man can be. And I may add that we have subjected them to severe and practical hard-working tests all the while, with the determination to discover, if possible, all latent or other defects of the system.

Yours Truly,

HENRY R. MILES,

General Sup't Telegraph & Telephone Service.

To R. S. WARING, ESQ.,
New York.



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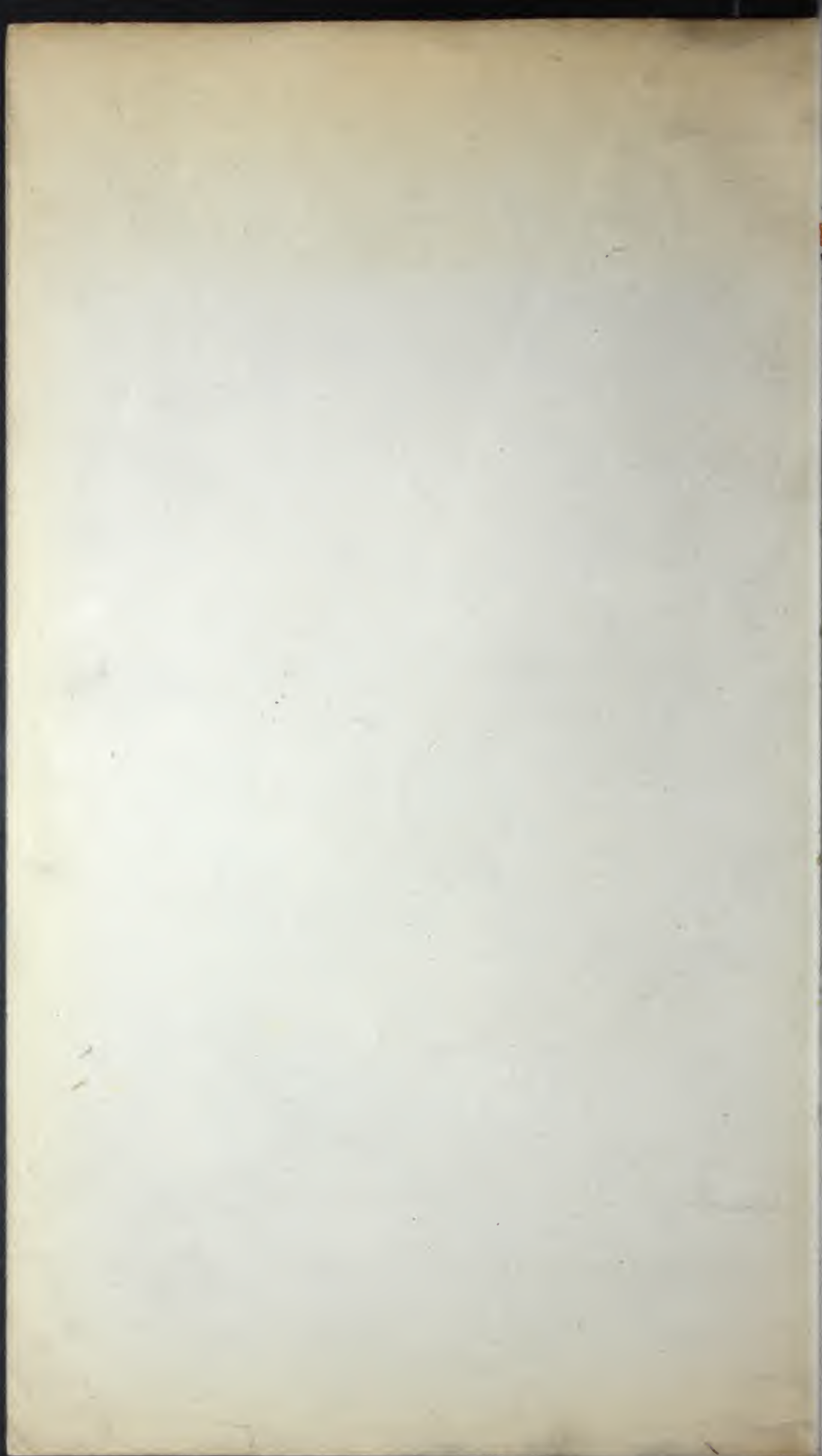
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